

AD-A082 221

CENTER FOR NAVAL ANALYSES ALEXANDRIA VA INST OF NAVAL--ETC F/G 5/9  
RECRUITERS, ADVERTISING, AND NAVY ENLISTMENTS.(U)

MAR 80 L GOLDBERG

CNA-PP-275

NL

UNCLASSIFIED

1 OF 1  
AD  
82-12-001




END  
DATE  
FILMED  
4-80  
DTIC

AD A 082221

9  
PROFESSIONAL PAPER 275 March 1980

14  
CNA-PP

2  
35

6  
**RECRUITERS, ADVERTISING,  
AND NAVY ENLISTMENTS.**

10  
Lawrence/Goldberg

11  
Mar 80

13  
43

DTIC  
SELECTE  
MAR 25 1980



CENTER FOR NAVAL ANALYSES

2000 North Beauregard Street, Alexandria, Virginia 22311

DDC FILE COPY

403542  
20 2 24 006

The ideas expressed in this paper are those of the author.  
The paper does not necessarily represent the views of the  
Center for Naval Analyses.

PROFESSIONAL PAPER 275 / March 1980

# **RECRUITERS, ADVERTISING, AND NAVY ENLISTMENTS**

Lawrence Goldberg



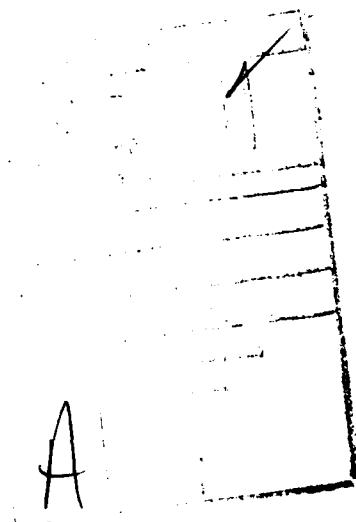
*Institute of Naval Studies*

**CENTER FOR NAVAL ANALYSES**

2000 North Beauregard Street, Alexandria, Virginia 22311

# ABSTRACT

▽ This study analyzes the effects on Navy high school graduate enlistments of various factors, including recruiters, advertising, unemployment rates, and others. Effects are measured using regression analysis with quarterly data from 1971 to 1977. The study should be of interest to those concerned with the problem of military manpower procurement, and to those interested in measuring the effects of advertising. A



## ACKNOWLEDGMENTS

I am indebted to Bob Lockman and John Warner for helpful comments. Claire Hughes did an outstanding job of computer programming. I would also like to thank Shirley Ellison, who did an excellent job of typing the often-changed manuscript.

## TABLE OF CONTENTS

	<u>Page</u>
Recruiters, advertising, and Navy enlistments . . . . .	1
Introduction . . . . .	1
Previous studies . . . . .	2
Regression model . . . . .	7
Supply factors . . . . .	7
HSG recruiting efforts . . . . .	7
Standards . . . . .	9
Population's awareness and advertising . . . . .	10
Measurement of awareness capital . . . . .	12
Relative economic benefits . . . . .	13
Pay . . . . .	13
Unemployment . . . . .	14
GI bill benefits . . . . .	14
Ending of the Draft . . . . .	15
Population . . . . .	15
Seasonal factors . . . . .	16
Specification of the model . . . . .	16
Estimation procedure . . . . .	19
Results . . . . .	21
Regression findings . . . . .	21
Tests of the model . . . . .	24
Marginal products of recruiters and advertising . . . . .	25
Recruiter and advertising cost per HSG . . . . .	28
Conclusions . . . . .	31
References . . . . .	33

## RECRUITERS, ADVERTISING, AND NAVY ENLISTMENTS

### INTRODUCTION

Navy recruiting efforts were largely successful until FY 1978. Since the advent of the All-Volunteer Force (AVF) in 1973, the Navy frequently achieved its enlistment goals or only slightly fell short. However, shortfalls averaged 10 percent in FY 1978 and FY 1979, and they are expected to increase further in the 1980s because of a decline in the youth population.

Similar recruiting problems have also been experienced by the other Services. As a result, some view the AVF as a failure and urge that we return to the Draft. But a draft involves many hidden social costs and inequities which make it an undesirable option.<sup>1</sup> Instead, solutions consistent with an AVF are likely to be less costly to society, if not the Defense Department's manpower budget, and such solutions should be chosen.

The Services' major difficulty has been an inability to recruit enough high quality male High School Graduate enlistments (HSGs). One set of AVF solutions involves options that would reduce demand for them. This could be accomplished, for example, by substituting for male HSGs, nonHSGs and HSGs in the lower mental groups as well as women and civilians.

---

<sup>1</sup>For discussion see reference 6, appendix M.



Another set of options would increase the supply of HSGs. One frequently recommended by economists is to raise military pay and benefits, but this is a costly option: higher pay must be given to the entire stock of manpower as well as to new recruits; enlistment bonuses are a more selective instrument, but they too must be paid to a large population (all enlistees).

Another option is to increase the amount of resources devoted to recruiting, i.e., Recruiters (R) and Advertising (A). This approach may be less expensive than raising pay or giving bonuses because it eliminates extra payments or rents to those who would volunteer anyway. Unfortunately there is little evidence on the productivity of R and A, so it is difficult to estimate the cost of using more to reduce shortfalls. To help evaluate such an alternative, this study analyzes the effects of recruiters and advertising on Navy HSGs.

#### PREVIOUS STUDIES

There have been numerous studies on enlistments.<sup>1</sup> In these regression analysis was used to relate the enlistment rate, e.g., HSGs per capita, to factors such as pay and unemployment. Typically it is assumed that HSGs are limited solely by supply factors and, therefore, the flow of HSGs is independent of demand

---

<sup>1</sup>For examples, see references 1-3, 5-15.

considerations. But this is a questionable assumption because the demand for enlistments seems to have had a strong effect on HSGs. As illustrated in figure 1, there is a strong relationship over the period FY 1972-78 between HSGs and the demand for total enlistments, i.e., quotas. The relationship seems to hold for all HSGs as well as those in the upper mental groups (MG1-3U)<sup>1</sup>. HSGs seem to be strongly affected by the demand for manpower.<sup>2</sup> Thus we observe a reduced form equation for HSGs rather than a supply function as assumed by previous researchers.

What might cause a positive association between quotas and HSGs? Perhaps recruiters simply worked less hard when faced with low quotas. Such a response seems reasonable as long as recruiting goals are achieved, which was largely the case prior to FY 1978.

In FY 1978, however, there were large shortfalls; as a result we presume a high level of recruiter effort -- yet there were relatively few HSGs. Thus, low recruiter effort does not explain why there were few HSGs in FY 1978. Still, changes in recruiter effort might partially explain figure 1 in earlier years.

---

<sup>1</sup>There are five mental groups. The upper mental groups are one, two, and the upper half of three.

<sup>2</sup>The Navy's demand for manpower is essentially independent of the supply of HSGs. Quotas are based on projections of total manpower requirements rather than on projections of supply factors such as unemployment rates.

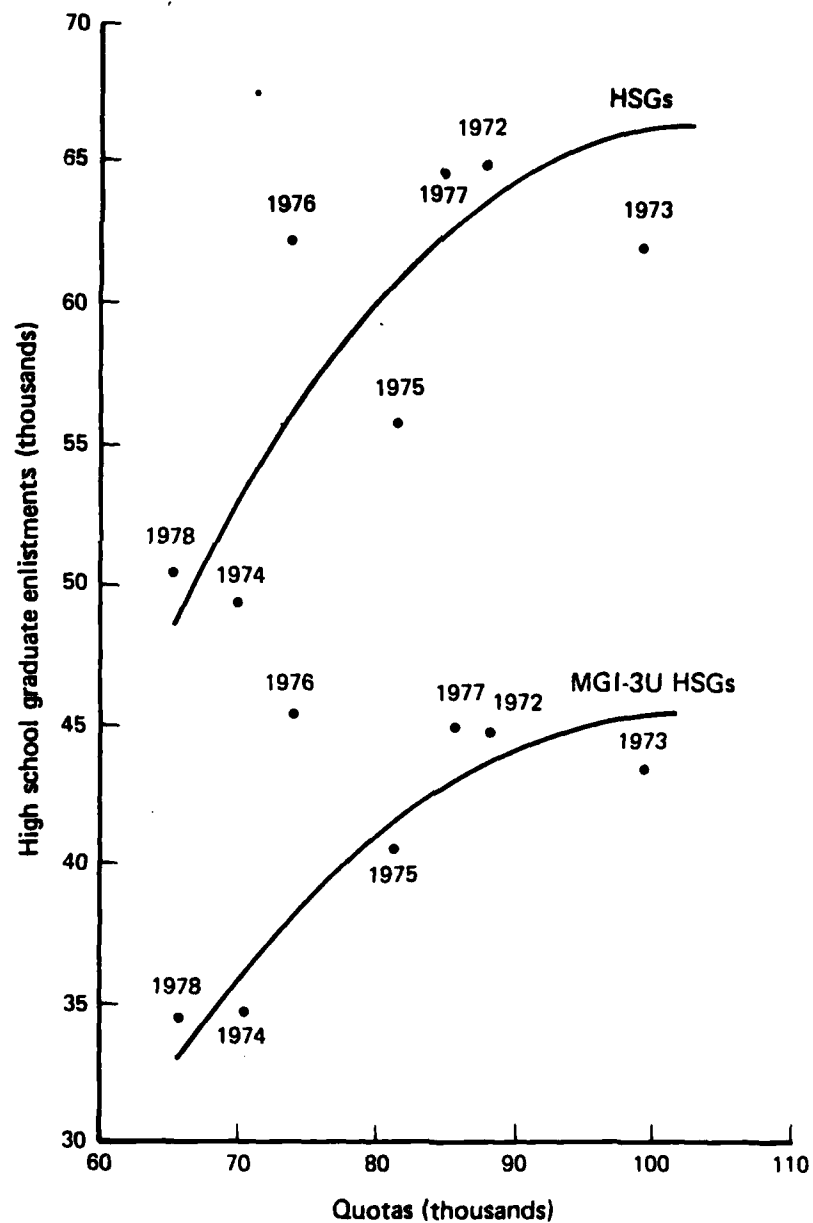


FIG. 1: QUOTAS AND HIGH SCHOOL GRADUATE ENLISTMENTS, FY 1972-78

A relationship between quotas and standards may better explain figure 1 as well as the FY 1978 results. The Navy has tended to lower standards to reduce shortfalls and raise them when faced with an excess supply of applicants.<sup>1</sup> For example, when faced with high quotas and the prospect of large shortfalls in FY 1972, standards were lowered enabling more high school graduates in the lower mental groups to enlist in the Navy.

As quotas changed, changes were brought about in certain supply factors. Whatever they are, recruiters' efforts or standards, it is necessary to control for their effects to measure the productivity of R and A.<sup>2</sup>

The study asks how many HSGs would be generated by additional R and A. We answer this question using regression analysis of

---

<sup>1</sup>For evidence on the relationship between quotas and standards, see reference 15, pp. 4-5, 17, and 28-29.

<sup>2</sup>During FY 1972-77, the Navy permitted standards to fall as a means of meeting enlistments goals. We suspect that what has happened recently, is that the Navy has set high standards and has decided to hold the line on them. Moreover, standards are probably so high that any past slack in recruiter effort has now largely disappeared. Because changing standards and recruiter effort no longer seem to be available as equilibration mechanisms, the Navy must look to other supply variables as a means of reaching its enlistment goals, or it must lower those goals by substituting other cohorts for male HSGs.

quarterly data for 3Q 1971 - 4Q 1977.<sup>1</sup> Our methodology is unusual in adjusting for the effects of changes in demand and in the treatment of advertising, which is considered a capital investment. The study provides the first estimate of the productivity of advertising in generating enlistments.

---

<sup>1</sup>The Draft was still in effect during the first six quarters (3Q 1971 - 4Q 1972) used to measure the effects of R and A. In reality, the Services treated this as a testing period for recruiting in an AVF environment. R and A were sharply increased, there were few inductions, and recruiters were pressured through high goals to produce large numbers of enlistments. It seems appropriate, therefore, to measure the effects of R and A with data from these quarters.

## REGRESSION MODEL

### SUPPLY FACTORS

We assume the supply of HSGs to the Navy depends on the following factors: (1) HSG recruiting efforts; (2) enlistment standards; (3) awareness of the Navy as a career choice; (4) relative economic benefits of enlisting; and (5) size of the youth population. Measures of these factors will be used to analyze high school graduate enlistments.

#### HSG Recruiting Efforts

Recruiters have more than a passive role; they visit high schools, for instance, and give talks on the advantages of a Navy career. We suspect that differences in recruiters' efforts have had measureable effects on HSGs. We therefore choose as a factor the effort recruiters made to enlist high school graduates.

This factor requires special handling because it cannot be measured directly: The Navy collects no systematic data on how much time recruiters spend in active search of high school graduates. We will have to use a number of variables to measure the effects of this factor.

The desired measure -- recruiter man-years devoted to enlisting high school graduates -- depends on the size of the recruiting force, their overall effort, and the percentage of time devoted to

recruiting high school graduates. The total number of personnel with a recruiter rating is included as a measure of the recruiting force. (This measure includes recruiters who are primarily administrators.<sup>1</sup> While we would have preferred to exclude administrators, data on the number of them are not available for the entire period.)

To adjust for differences in total effort per recruiter, we would prefer to use the exogenously determined quota. Instead we use actual enlistments (E) because quarterly quota data are unavailable for FY 1972.<sup>2</sup> Since the Navy generally makes goal during the regression period -- the shortfall averages 3.5 percent -- total enlistments is, with a few exceptions, a close approximation of the quota and, therefore, it too is exogenously determined.

Since CY 1975, all the Services have been pressured by Congress and the Department of Defense to increase the quality of enlistments. The Services responded by limiting mental group four enlistments and by increasing recruiters' efforts devoted to

---

<sup>1</sup>In FY 1977, about 18 percent of the recruiting force were administrators. These recruiters did not receive quotas. Administrators are all recruiters except production recruiters and recruiters in charge of stations having three or less recruiters.

<sup>2</sup>We cannot simply drop quarters in FY 1972, because there are too few observations and most of the variation in recruiters occurs that year.

enlisting high school graduates. A dummy variable (NAVPL) is included to adjust for the change in high school graduate recruiting effort starting in CY 1975.

### Standards

We suspect that changes in standards strongly affected HSGs. Since accurate data on standards are unavailable, we are forced to again use total enlistments as a proxy.<sup>1</sup> We assume that standards for HSGs declined as the Navy increased its demand for total enlistments. HSGs increased as standards were lowered, because the Navy accepted more HSGs in the lower mental groups and waived various entry requirements for them.

Lacking data on HSG recruit effort and standards applying to them, we use total enlistments as a proxy for both: we assume that as E increases, HSG recruiting effort increases and standards applying to HSGs decline; these changes increase the supply of HSGs. We also use a dummy variable (NAVPL) as a proxy for changes in HSG recruiting effort not captured by E.

We assume HSG supply and demand are in balance in every quarter during the regression period. As demand for total enlistments

---

<sup>1</sup>Another problem is that standards are multi-dimensional. Even if data were available on the many components of standards, increasing the number of variables when there are so few data points would reduce the statistical reliability of the results.



increase, there is an increase in the demand for HSGs. This is met by increasing the supply of HSGs through increases in recruiting effort and reductions in standards.

Thus, we do not observe a given supply function in the sense that recruiter effort and standards are unchanging throughout the regression period.<sup>1</sup> Instead, we observe points on a shifting supply function caused by changes in these factors, and shifts are linked to the Navy's total demand for enlistments. By including E and NAVPL we adjust for such changes, and estimate a reduced form equation for high school graduate enlistments.

#### Population's Awareness and Advertising

Previous studies on advertising have focused on measuring its effects in product markets: the consensus is that advertising increases a product's demand in current and future periods, but its effects decline over time.<sup>2</sup>

Therefore, we treat Navy advertising as an investment in a stock of intangible "awareness capital" which depreciates over time. This treatment permits its effects to last for more than one

---

<sup>1</sup>Here our approach is different from that taken by most previous researchers. They have assumed recruiters' efforts and standards are unchanging.

<sup>2</sup>For a review of literature on this issue, see reference 4.

period and to decline over time. We estimate the effects of awareness capital on HSGs, and given that, calculate the effect of advertising from the relationship between it and awareness capital.

Construction of a capital stock series for advertising requires that we have data on the advertising effort each quarter, as well as the base period stock and the depreciation rate of awareness capital. Only annual data are available on advertising; lacking quarterly data, we assume the annual advertising budget is spent evenly over the fiscal year. We also assume that 250 dollars in this quarter's advertising budget (in constant 1967 dollars) generates one unit of awareness capital in the following quarter.<sup>1</sup>

Because the other data are unavailable we still face serious measurement problems, but estimation procedures are developed to handle them. A way is found to express the base period stock as a regression parameter. This eliminates the need to know it to construct the awareness capital series. A maximum likelihood procedure is used to solve the problem of not knowing the depreciation rate.

---

<sup>1</sup>Advertising was adjusted for inflation using an overall media price index prepared by the McCann-Erickson advertising agency.

### Measurement of Awareness Capital

Let  $K_0$  be the base period stock of awareness capital and  $\delta$  its depreciation rate per quarter. In subsequent periods the net capital stock depends on  $K_0$ ,  $\delta$ , and the stream of advertising investments ( $I_t$ ):

$$K_1 = K_0(1-\delta) + I_0$$

$$K_2 = K_0(1-\delta)^2 + I_0(1-\delta) + I_1$$

$$K_3 = K_0(1-\delta)^3 + I_0(1-\delta)^2 + I_1(1-\delta) + I_2$$

⋮

$$K_t = K_0(1-\delta)^t + I_0(1-\delta)^{t-1} + I_1(1-\delta)^{t-2} + \dots + I_{t-1}$$

The net capital stock in any period  $t$  (except for the base period) can be written as the sum of two expressions

$$K_t = K_0 X_t(\delta) + Y_t(\delta) \quad (1)$$

where

$$X_t(\delta) = (1-\delta)^t$$

$$Y_t(\delta) = I_0(1-\delta)^{t-1} + I_1(1-\delta)^{t-2} + \dots + I_{t-1}$$

By defining  $Y_0$  equal to zero, equation (1) also holds in the base period.

Our approach is to include both  $X_t(\delta)$  and  $Y_t(\delta)$  as explanatory variables in a regression model relating HSGs to various factors. For example, given the regression model

$$\text{dependent variable} = \dots + a \cdot K_t + \dots \quad (2)$$

we substitute for  $K_t$  to yield

$$\text{dependent variable} = \dots + a \cdot K_0 X_t(\delta) + a \cdot Y_t(\delta) + \dots \quad (3)$$

Along with  $K_0$ ,  $X_t(\delta)$  and  $Y_t(\delta)$  measure the stock of awareness capital. The coefficient of  $Y_t(\delta)$  is the effect on the dependent variable in the regression model of a one unit change in the awareness capital stock.

The coefficient of  $X_t(\delta)$  is equal to the coefficient of  $Y_t(\delta)$  times  $K_0$ . Both variables should have a positive sign. An F-test on  $X_t(\delta)$  and  $Y_t(\delta)$  together is used to test whether awareness capital has a statistically significant effect on HSGs.

#### Relative Economic Benefits

Four factors are included to measure changes in relative economic benefits.

#### Pay

The first is the ratio of military to civilian pay. Holding other factors constant, it is expected to have a positive effect on HSGs. The preferred measure involves using the ratio of civilian to military discounted earnings streams. However, assuming long-run earnings growth rates of civilians and enlistees are roughly the same, the measure reduces to simply the ratio of military to

civilian pay in a base period. We make this assumption and use as our measure of relative pay the ratio of expected military to expected civilian earnings during an enlistee's first term.

Civilian pay is measured by the sum of four-years' full-time, before-tax earnings for a typical 18-21 year old male worker. Similarly, military pay is measured by four-years's before-tax base pay for a typical enlistee. We exclude from military pay in-kind earnings (quarters and subsistence allowances and their tax advantage), since they have hardly changed in real terms over the period.

#### Unemployment

The second factor is the unemployment rate (UNEMP). As it increases, expected civilian earnings decline and it becomes more difficult and costly to find a civilian job. The unemployment rate of 16-19 yer old white males is used to measure unemployment.<sup>1</sup> An increase in the unemployment rate is expected to increase HSGs.

#### GI Bill Benefits

Starting in January 1977, GI Bill benefits were reduced and the government no longer paid for all of a veteran's post-service

---

<sup>1</sup>Unemployment rates for other youth cohorts could have been used; but because they tend to move together so closely, we did not experiment with other rates.

education. Instead, for every dollar the individual pays the government will contribute two.<sup>1</sup> This change reduced the relative economic benefits of enlisting. A dummy variable starting in January 1977 (GIBL) is included as a factor. It is expected to reduce HSGs.

#### Ending of the Draft

Although the law authorizing conscription expired on 1 July 1973, for all practical purposes, the Draft ended in January 1973. By eliminating the risk of having to serve in the Army, ending the Draft decreased the benefits of enlisting in the Navy. An All-Volunteer Force dummy variable starting in January 1973 (AVF) is included. Its coefficient is expected to have a negative sign.

#### Population

The eligible population (POP) is measured by the number of civilian males ages 18-24. (We could use other cohorts, such as 18-19 year olds, but they move together almost perfectly with the 18-24 year old group, so it would not matter statistically which one is chosen.)<sup>2</sup> We expect that an increase in population would increase HSGs.

---

<sup>1</sup>For discussion see reference 6, p. 27.

<sup>2</sup>The 18-19 year old group equaled 30.9 percent + 0.7 percent of the 18-24 year old cohort over the period 1971-1976.

### Seasonal Factors

Seasonal factors such as the ending of the school year affect the quarterly flow of HSGs. We include dummy variables for first, second, and third quarters (Q1, Q2, and Q3) to account for these factors. We expect the third quarter dummy variable, which coincides with the end of the school year, to have a positive coefficient. We have no strong expectations concerning the signs of the other seasonal dummy variables.

### SPECIFICATION OF THE MODEL

As suggested by figure 1, we specify HSGs and MGI-3U HSGs to be nonlinear functions of total enlistments (E)<sup>1</sup>

$$H = E \sum_i a_i Z_i - bE^2 + cE + v \quad (4)$$

where H = HSGs or MGI-3U HSGs and the  $Z_i$  are the following factors.

PAY = Four years' military pay divided by four years' civilian pay

UNEMP = Unemployment rate of white males, 16-19 year old

POP = 18-24 year old male population

---

<sup>1</sup>By using E instead of quotas we still estimate figure 1. It is shifted slightly to the left, however, because E was 96.5 percent of quotas during the regression period. HSGs and E are nonprior service males excluding reservists.

GIBL = Dummy variable (equal to one for quarters starting in 1977, zero otherwise) measuring effects of declines in GI Bill benefits

NAVPL = Dummy variable (equal to one for quarters starting in 1975, zero otherwise) measuring effects of a Navy policy which increased HSG recruiting efforts

AVF = Dummy variable (equal to one for quarters starting in 1973, zero otherwise) measuring effects of the ending of the Draft

RECR = Number of recruiters

$X_t(\delta) = (1-\delta)^t$  for  $\delta$ s between 5 and 25 percent

$Y_t(\delta) = I_0(1-\delta)^{t-1} + I_1(1-\delta)^{t-2} + \dots + I_{t-1}$  where  $I_t$  is the advertising budget adjusted for inflation in  $t$  and  $\delta$ s are between 5 and 25 percent

$Q_1$  = Dummy variable (equal to one in first calendar quarter, zero otherwise) measuring seasonality of enlistments

$Q_2$  = Dummy variable (equal to one in second calendar quarter, zero otherwise) measuring seasonality of enlistments

$Q_3$  = Dummy variable (equal to one in the third calendar quarter, zero otherwise) measuring seasonality of enlistments

$c$  = Constant term

$v$  = Error term.



This functional form is chosen because it is consistent with two assumptions about the underlying mechanism. The first is that the contribution of each  $Z_i$  to the number of HSGs should depend on recruiter effort and HSG recruiting standards, represented by the proxy  $E$ . The equation conforms in this respect: the coefficient of  $Z_i$  is  $Ea_i$ . In terms of changes in  $H$ , which we may want to bring about through policy:

$$\frac{\partial H}{\partial Z_i} = Ea_i \frac{1}{E}. \quad (5)$$

The second assumption is that the contribution of recruiter effort and standards should show decreasing returns. That is, if recruiters are already aggressive and standards are already low, further changes of this nature should exhibit diminishing returns. The equation conforms because of the negative coefficient of  $E$ :

$$\frac{\partial H}{\partial E} = \sum_i a_i Z_i - 2bE + c \quad (6)$$

---

<sup>1</sup>This implies constant marginal effects. We tested this assumption for recruiters.

## ESTIMATION PROCEDURE

It might be inappropriate to apply equation (4) to the data directly.<sup>1</sup> One of the assumptions of "ordinary least squares" regression is that the error term does not depend systematically on any of the variables. In the present case, however, the error term seems to depend on E; this might lead us to overestimate the variances of parameters. To remove the problem, we divide equation (4) by E.<sup>2</sup>

For this reason, the regression equation to be estimated is:

$$\frac{H}{E} = \sum_i a_i z_i - bE + c + \mu \quad (7)$$

where the error term  $\mu$  equals  $\nu/E$ .<sup>3</sup>

---

<sup>1</sup>Data were obtained from the Navy Recruiting Command, the Defense Manpower Data Center, the McCann-Erickson advertising agency, the Urban Institute, and published sources. For details, see reference 9, appendix A.

<sup>2</sup>The problem is technically one of "heteroscedasticity." For more discussion, see reference 17, pp. 259-61.

<sup>3</sup>Equation (4) was also estimated for HSGs. Results change slightly when equation (7) is used instead of equation (4). While the pattern is the same, some coefficients obtained with equation (4) are about 20 percent larger in absolute value. The greatest difference is in the pay coefficient which is 50 percent larger.

Once the coefficients  $a_i$  are obtained, equation (5) is used for estimating R and A productivities.

A search procedure is used to obtain maximum likelihood estimates. Adjusting for autocorrelation using the Cochrane-Orcutt technique,<sup>1</sup> regression models for HSGs and MGl-3U HSGs are estimated assuming alternative awareness capital depreciation rates per quarter within the relevant range, e.g., in percents 5, 6, ..., 25. For both HSGs and MGl-3U HSGs, the models that maximized the likelihood function are those for which the depreciation rate is 11 percent.<sup>2</sup> These best-fit models yield the maximum likelihood estimates of parameters including  $\delta$ .<sup>3</sup>

---

<sup>1</sup>For discussion, see reference 17, pp. 277-84.

<sup>2</sup>To derive the likelihood function, it is assumed that, after adjusting for autocorrelation, error terms of the regression model given by equation (7) are independent and normally distributed, having a zero mean and constant variance in each quarter.

<sup>3</sup>For more discussion on the estimation procedure, see (16) and (17).

## RESULTS

### REGRESSION FINDINGS

Maximum likelihood estimates and their t-values are reported in table 1. A number of factors have statistically significant effects on high school graduate enlistments. For all HSGs, total enlistments and the third quarter dummy variable are significant at the one percent level. The unemployment rate, the number of recruiters, and awareness capital, i.e.,  $X(11)$  and  $Y(11)$  together, are significant at the five percent level. Population and dummy variables GIBL and NAVPL are significant at the ten percent level. PAY, AVF,  $Q_1$ , and  $Q_2$  are not statistically significant.<sup>1</sup> The results for MG1-3U HSGs are similar to those for all HSGs.

The high adjusted  $R^2$ s indicate that the models explain most of the variation in the dependent variables. According to the F-statistics, the models are statistically significant at the one percent level. The t-statistics for Rho suggest that adjustments for autocorrelation are perhaps necessary only in the regression model for all HSGs.

---

<sup>1</sup>The result for PAY is probably due to there having been little independent variation: most of the variation consisted of a slight decline toward the end of the regression period when the Navy put a greater emphasis on recruiting HSGs. Thus the negative effects of relatively small declines in PAY were probably overwhelmed by the positive effects of changes in other variables, e.g., recruiting effort.

TABLE 1  
REGRESSION FINDINGS

Independent variables	% HSG	t	% MG1-3U	t
CONSTANT	-7.99	-1.60 <sup>a</sup>	-3.62	-0.90
PAY	0.655	1.29	0.120	0.28
UNEMP	0.0299	2.64 <sup>b</sup>	0.0219	2.02 <sup>b</sup>
POP	0.000515	1.63 <sup>a</sup>	0.000217	0.84
E	-0.0000108	2.94 <sup>c</sup>	-0.0000105	3.30 <sup>c</sup>
RECR	0.000244	2.34 <sup>b</sup>	0.000215	2.50 <sup>b</sup>
X(11)	2.01	1.99 <sup>b</sup>	1.18	1.44 <sup>a</sup>
Y(11)	0.00000231	1.32 <sup>d</sup>	0.000000852	0.58 <sup>d</sup>
GIBL	0.0453	1.57 <sup>a</sup>	0.00306	0.10
NAVPL	0.0972	1.68 <sup>a</sup>	0.153	2.92 <sup>c</sup>
AVF	-0.0430	-0.54	0.0273	0.38
Q <sub>1</sub>	-0.0307	-1.26	-0.0180	-1.02
Q <sub>2</sub>	0.0305	1.56	-0.0144	0.10 <sup>b</sup>
Q <sub>3</sub>	0.157	3.10 <sup>c</sup>	0.105	2.52 <sup>b</sup>
$\bar{R}^2$	0.899	N.A.	0.905	N.A.
F (13,11)	17.4 <sup>c</sup>	N.A.	18.6 <sup>c</sup>	N.A.
D-W	2.63	N.A. <sup>b</sup>	2.15	N.A.
Rho	-0.469	2.65 <sup>b</sup>	-0.191	-0.97

<sup>a</sup>Statistically significant at ten percent level.

<sup>b</sup>Statistically significant at five percent level.

<sup>c</sup>Statistically significant at one percent level.

<sup>d</sup>F-test of X(11) and Y(11) together indicates statistical significance at five percent level for HSGs and ten percent level for MG1-3U HSGs.

Although awareness capital is statistically significant, its impact measured by the coefficient of  $Y(11)$  is imprecise.<sup>1</sup> This may be caused by high collinearity between  $X(11)$  and  $Y(11)$  (the simple correlation coefficient between them is  $-0.95$ ).

Except for GIBL, all variables have the expected sign.<sup>2</sup> The effect is positive for PAY, unemployment, population, NAVPL, recruiters,  $X(11)$ ,  $Y(11)$  and  $Q_3$ , and negative for total enlistments and AVF.<sup>3</sup>

---

<sup>1</sup>Imprecise estimates of  $X(11)$  and  $Y(11)$  may explain a peculiar result obtained for the estimate of the base period capital stock ( $K_0$ ). It is calculated by the ratio of  $X(11)$  and  $Y(11)$  coefficients. For HSGs the estimate of  $K_0$  is about 870 thousand units of awareness capital. Although the estimate is positive, as expected, it seems too high. Given a depreciation rate of 11 percent per quarter, to obtain such a high steady-state level would require advertising to be about \$24 million per year. Prior to FY 1972, however, advertising was at much lower levels. Since we use the ratio of imprecise estimates to calculate  $K_0$ , its estimate is also likely to be imprecise. Perhaps this explains the high estimate of  $K_0$  obtained.

<sup>2</sup>The unexpected sign for GIBL is probably caused by the fact that a relatively large number of contracts were signed just prior to reduction of G.I. Bill benefits in the first quarter of CY 1977. This caused a spillover of HSGs in 1977, which would tend to reverse the sign for the G.I. Bill quarters -- 1Q 1977 - 4Q 1977.

<sup>3</sup>The sign of AVF changes direction for MGI-3U HSGs, but it is not statistically significant in either model.

### Tests of the Model

In measuring the effects of R and A, we assume that advertising operates through a stock of awareness capital having an 11 percent depreciation rate, and that recruiters have an immediate, constant marginal effect. We also estimated the model assuming other treatments of R and A, which yielded evidence supporting our approach and findings.

Treating advertising as a stock rather than a flow improves the fit of equation (7). Changing the depreciation rate reinforces the finding that the effect of advertising is measured imprecisely; however, it has little effect on the recruiter's coefficient or significance level. We also experimented with models that included lagged recruiters and current recruiters squared. Only current recruiters seem to be important, and their marginal productivity appears to be constant over the range of recruiting force levels observed.<sup>1</sup>

To check the stability of the model, we predicted HSGs in CY 1978 using actual levels of explanatory variables. Predictions are given in table 2. The model does well: it predicts the sharp decline in HSGs with only a 2.1 percent error for the year. These results increase our confidence in the model and the implied estimates of marginal products for R and A.

---

<sup>1</sup>For details, see reference 9, appendix B.

TABLE 2  
HSG PREDICTIONS FOR CY 1978

<u>Quarter</u>	<u>Predictions</u>	<u>Actuals</u>	<u>Predictions - actuals</u>	<u>Percent errors</u>
1	9,950	9,880	70	0.7
2	10,440	10,989	-549	-5.0
3	17,731	18,344	-613	-3.3
4	9,631	9,571	60	0.6
Year	47,752	48,784	-1,032	2.1

The model was estimated with data from a period when HSGs were greatly affected by demand considerations, probably through changes in standards. The model essentially uses goals as a proxy for standards, and in CY 1978 goals were sharply lowered. The predictive accuracy of the model suggests that the low level of HSGs achieved in CY 1978 was partly due to increases in standards, and that HSGs might be increased in the future by lowering entry restrictions.

#### MARGINAL PRODUCTS OF RECRUITERS AND ADVERTISING

Marginal products (MPs) and elasticities for CY 1978 are given in table 3. An additional recruiter would yield 14.0 HSGs of which 12.3 would be MGI-3Us. Thus, most of the recruiters' impact is on HSGs in the upper mental groups. These enlistments are generated



TABLE 3

EFFECTS OF RECRUITERS AND ADVERTISING IN CY 1978<sup>a</sup>

Supply factors	All HSGs (48,784)		MGl-3U HSGs (29,844) <sup>b</sup>	
	MP	Elasticity	MP	Elasticity
One recruiter				
All (3425)	14.0	0.98	12.3	1.42
Except adminis- trators (2808)	14.0	0.80	12.3	1.16
\$1M advertising <sup>c</sup> (\$10 million)	1206	0.25	445	0.15

<sup>a</sup>Numbers in parentheses are CY 1978 levels of variables which are used to calculate elasticities.

<sup>b</sup>Estimated from ratio of MGl-3U HSGs to all HSGs in first three quarters of CY 1978, e.g., 0.61.

<sup>c</sup>Effect of \$1 million of advertising.

immediately, based on our experiments with other models including lagged recruiters.

The recruiter elasticity is 0.98 for HSGs, but if we exclude administrators it is only 0.80. The lower elasticity is probably more accurate. This is because the regression model yields an estimate for the type of recruiter added during the regression period, and we suspect that few of those added were administrators.

A once-and-for-all increase in the advertising budget of \$1 million would yield 1,206 HSGs in the long-run. Only 445 or 37 percent would be in the upper mental groups, however.<sup>1</sup>

The effects of advertising are felt mostly in the future. Based on the estimated depreciation rate of 11 percent per quarter, we calculate that only 30 percent of the total impact is felt this year; it takes four years for 82 percent to accrue.

Thus, R and A both affect HSGs, but the effects differ in two important respects which make advertising less attractive: unlike recruiters, advertising predominately affects HSGs in the lower

---

<sup>1</sup>For details on how the effects of advertising are calculated, see reference 9, appendix C.

mental groups; and, rather than this year, most of its effects are felt in the future.

#### RECRUITER AND ADVERTISING COST PER HSG

Given marginal productivities and estimates of marginal costs, we calculate the cost of generating HSGs with R and A. These are given in table 4. As discussed earlier, a \$1 million increase in advertising in 1967 dollars would yield 1,206 HSGs in the long-run. Given the change in advertising costs since 1967, in CY 1978 it would take \$2.2 million of advertising to produce what \$1 million could buy in 1967. The ratio of \$2.2 million to 1,206 HSGs or \$1,824 is advertising's marginal cost for HSGs. The cost per MG1-3U HSG is \$4,944.

The cost of an additional recruiter in CY 1978 was about \$31,000. Given the recruiter productivities in table 3, the marginal cost of enlistments is \$2,214 for HSGs and \$2,520 for MG1-3U HSGs.

Although in the long run the cost per HSG is slightly lower for advertising, in the short run it is more costly than recruiters. This is because only 30 percent of the HSGs generated by advertising accrue in the first year. As a result, the cost per HSG generated in the first year is about three times higher than recruiters'. To calculate it, we divide \$2.2 million by the HSGs generated by advertising in the first year (362) to yield a cost of \$6,077 per HSG.

TABLE 4  
LONG-RUN COST PER HSG IN CY 1978 FOR  
ONE RECRUITER AND \$1 MILLION OF ADVERTISING

Group	<u>\$1 million advertising</u>			<u>One recruiter</u>		
	<u>Marginal productivity</u>	<u>Marginal cost<sup>a</sup> (millions)</u>	<u>Cost per HSG</u>	<u>Marginal productivity</u>	<u>Marginal cost<sup>b</sup></u>	<u>Cost per HSG</u>
All HSGs	1,206	\$2.2	\$1,824	14.0	\$31,000	\$2,214
MGI-3U HSGs	445	\$2.2	\$4,944	12.3	\$31,000	\$2,520

<sup>a</sup>The marginal cost of \$1 million of advertising equals the advertising price index times \$1 million. The price index is forecast to be 2.2 in CY 1978, based on the 1977 price level (2.02) adjusted upward by the 1977 rate of inflation (9 percent).

<sup>b</sup>Marginal cost includes: \$19,000 for recruiter's salary, allowances, retirement, training, reenlistment bonus, and special pay; and \$12,000 for support costs including salaries and operations and maintenance expenses.

In summary, the long-run cost of generating HSGs is about the same for R and A -- \$2,000 per HSG. For MG1-3U HSGs in the long or short run and for all HSGs in the short run, it is less costly to use recruiters.

## CONCLUSIONS

Our findings suggest that R and A could be used to increase high school graduate enlistments. But, since advertising affects HSGs mostly in the lower mental groups, the mix of additional R and A should be weighted more heavily towards recruiters.

With regard to temporary shortfalls, additional resources are needed that would have an immediate effect. Since about half of the HSGs generated by advertising accrue after the second year, the proper strategy is to add just recruiters.

Changes in the unemployment rate have an important effect on HSGs: a one percentage point increase in the youth unemployment rate would yield about 1,700 HSGs and 1250 would be in the upper mental groups; elasticities are 0.46 for HSGs and 0.55 for MG1-3U HSGs. Because of its impact and tendency to change frequently, unemployment should be taken into account when formulating near-term R and A requirements.

The recruiting difficulty of the Navy in FY 1978-79 is probably due to a number of reasons: an increase in standards, a reduction in unemployment rates, and possibly also an erosion of relative pay and benefits. The shortfall of HSGs has been a modest 10 percent. It can probably be met with modest increases in R and A and reductions in standards.

In the 1980s, however, the shortfall would be larger than 10 percent. There will be a reduction in the youth population which will not only reduce the eligible population, it is also likely to lead to lower unemployment rates and higher civilian wages. These changes would further reduce the supply of HSGs. Therefore, future shortfalls are likely to be larger, and to meet them may require increases in military pay and benefits in addition to the remedies previously suggested.

Regarding methodology, measurement of the productivity of advertising is difficult because (1) advertising seems to have only slight effects which are distributed over time, and (2) HSGs are strongly affected by other supply factors as well as by demand considerations. These problems were overcome by treating advertising as an investment in awareness capital, and by including it and numerous other factors in a reduced form regression model.

While our methodology is interesting, the data are extremely crude and estimates are based on only 26 observations. Therefore, results and policy recommendations should be viewed as highly tentative. More research is needed to provide a solid basis for R and A policymaking.

## REFERENCES

1. Altman, S.H., "Earnings, Unemployment and the Supply of Enlisted Volunteers," Journal of Human Resources, IV-1 (1969), pp. 38-59
2. Bennett, J.T., Haber, S.E., and Kinn, P.K., The Supply of Volunteers to the Armed Forces Revisited, Institute for Management Science and Engineering, The George Washington University, Washington, D.C., 1972
3. Binkin, M. and Johnston, J.D., All Volunteer Armed Forces: Progress, Problems and Prospects, prepared for the Committee on Armed Services, U.S. Senate, 93rd Congress, 1st Session. The Brookings Institution, 1 June 1973.
4. Clarke, D.G., "Econometric Measurement of the Duration of Advertising Effect on Sales," Journal of Marketing Research, Vol. III (November 1976), pp. 345-57.
5. Cook, A.A. and White, J.P. "Estimating the Quality of Air Force Volunteers," Rand Corporation Paper No RM-6360-PR, September 1970
6. Cooper, Richard V.L., "Military Manpower and The All-Volunteer Force," Rand Corporation Paper No. R-1450-ARPA, September 1977
7. Fisher, A.C., "The Cost of the Draft and the Cost of Ending the Draft," American Economic Review, LIX(1969), pp. 239-254
8. Fechter, A.E., "Impact of Pay and Draft Policies in Army Enlistment Behavior," The Report of the Presidential Commission on an All Volunteer Force, II-3-1-59, Washington, D.C., U.S. Government Printing Office, November 1970.
9. Goldberg, L. "Recruiters, Advertising, and Navy Enlistments," Center for Naval Analyses, CRC 409, November 1979
10. Gray, B.C., "Supply of First-Term Military Enlistees," The Report of the Presidential Commission on an All Volunteer Force, II-2-1-40, Washington, D.C., U.S. Government Printing Office, November 1974



11. Greenston, P.M. and Toikka, R.S., "The Determinants of Navy Recruit Quality: Theory and Evidence 1970-1977," The Urban Institute Technical Report No. 1168, October 1978
12. Grissmer, D.W., et al., An Econometric Analysis of Volunteer Enlistments by Service and Cost Effectiveness Comparison of Service Incentive Programs, General Research Corporation, October 1974
13. Grissmer, D.W., et al., Marine Corps Recruiter Allocation and Quota Determination, General Research Corporation, February 1974
14. Jehn, C. and Shughart, W.F., "Recruiters, Quotas and the Number of Enlistments," Center for Naval Analyses, CNS 1073, December 1976
15. Kim, K.H., et al., The All-Volunteer Army: An Analysis of Demand and Supply (New York: Praeger Publishers, 1971)
16. Klein, L.R., "The Estimation of Distributed Lags," Econometrica, October 1958, pp. 553-65
17. Maddala, G.S., Econometrics, McGraw-Hill, New York, 1977
18. Navy Recruiting Command, "NRC Policies FY 1971 - FY 1977: Extracts," Unclassified, Apr 1979 (00 201296)
19. Shucker, R.E., "Further Analysis of the Test of Paid Radio Advertising for the Armed Services Recruitment," Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs), March 1977
20. Wallace, D., "Pretest Estimation in Regression: A Survey," American Journal of Agricultural Economics, Aug 1977, pp. 431-43

## CNA Professional Papers – 1976 to Present\*

- PP 141  
Mizrahi, Maurice M., "Generalized Hermite Polynomials," 5 pp., Feb 1976 (Reprinted from the Journal of Computational and Applied Mathematics Vol. 1, No. 4 (1975), 273-277)  
\*Research supported by the National Science Foundation
- PP 142  
Horowitz, Stanley and Sherman, Allan (LCDR, USN), "Maintenance Personnel Effectiveness in the Navy," 33 pp., Jan 1976 (Presented at the RAND Conference on Defense Manpower, Feb 1976) AD A021 581
- PP 144  
Durch, William J., "The Navy of the Republic of China – History, Problems, and Prospects," 66 pp., Aug 1976 (Published in "A Guide to Asiatic Fleets," ed. by Barry M. Blechman and Robert Berman, Naval Institute Press) AD A030 460
- PP 145  
Kelly, Anne M., "Port Visits and the 'Internationalist Mission' of the Soviet Navy," 36 pp., Apr 1976, AD A023 436
- PP 147  
Kessler, J. Christian, "Legal Issues in Protecting Offshore Structures," 33 pp., Jun 1976 (Prepared under task order N00014-68-A-0091-0023 for ONR) AD A028 389
- PP 149  
Squires, Michael L., "Counterforce Effectiveness: A Comparison of the Tsipis 'K' Measure and a Computer Simulation," 24 pp., Mar 1976 (Presented at the International Study Association Meetings, 27 Feb 1976) AD A022 591
- PP 150  
Kelly, Anne M. and Petersen, Charles, "Recent Changes in Soviet Naval Policy: Prospects for Arms Limitations in the Mediterranean and Indian Ocean," 28 pp., Apr 1976, AD A 023 723
- PP 151  
Horowitz, Stanley A., "The Economic Consequences of Political Philosophy," 8 pp., Apr 1976 (Reprinted from Economic Inquiry, Vol. XIV, No. 1, Mar 1976)
- PP 152  
Mizrahi, Maurice M., "On Path Integral Solutions of the Schrodinger Equation, Without Limiting Procedure," 10 pp., Apr 1976 (Reprinted from Journal of Mathematical Physics, Vol. 17, No. 4 (Apr 1976), 566-575)  
\*Research supported by the National Science Foundation
- PP 153  
Mizrahi, Maurice M., "WKB Expansions by Path Integrals, With Applications to the Anharmonic Oscillator," 137 pp., May 1976, AD A025 440  
\*Research supported by the National Science Foundation
- PP 154  
Mizrahi, Maurice M., "On the Semi-Classical Expansion in Quantum Mechanics for Arbitrary Hamiltonians," 19 pp., May 1976 (Published in Journal of Mathematical Physics, Vol. 18, No. 4, p. 786, Apr 1977), AD A025 441
- PP 155  
Squires, Michael L., "Soviet Foreign Policy and Third World Nations," 26 pp., Jun 1976 (Prepared for presentation at the Midwest Political Science Association meetings, Apr 30, 1976) AD A028 388
- PP 156  
Stallings, William, "Approaches to Chinese Character Recognition," 12 pp., Jun 1976 (Reprinted from Pattern Recognition (Pergamon Press), Vol. 8, pp. 87-98, 1976) AD A028 692
- PP 157  
Morgan, William F., "Unemployment and the Pentagon Budget: Is There Anything in the Empty Pork Barrel?" 20 pp., Aug 1976 AD A030 455
- PP 158  
Haskell, LCDR Richard D. (USN), "Experimental Validation of Probability Predictions," 25 pp., Aug 1976 (Presented at the Military Operations Research Society Meeting, Fall 1976) AD A030 458
- PP 159  
McConnell, James M., "The Gorshkov Articles, The New Gorshkov Book and Their Relation to Policy," 93 pp., Jul 1976 (Published in Soviet Naval Influence: Domestic and Foreign Dimensions, ed. by M. McGwire and J. McDonnell, New York: Praeger, 1977) AD A029 227
- PP 160  
Wilson, Desmond P., Jr., "The U.S. Sixth Fleet and the Conventional Defense of Europe," 50 pp., Sep 1976, AD A030 457
- PP 161  
Melich, Michael E. and Peet, Vice Adm. Ray (USN, Retired), "Fleet Commanders: Afloat or Ashore?" 9 pp., Aug 1976 (Reprinted from U.S. Naval Institute Proceedings, Jun 1976) AD A030 456
- PP 162  
Friedheim, Robert L., "Parliamentary Diplomacy," 106 pp., Sep 1976 AD A033 306
- PP 163  
Lockman, Robert F., "A Model for Predicting Recruit Losses," 9 pp., Sep 1976 (Presented at the 84th annual convention of the American Psychological Association, Washington, D.C., 4 Sep 1976) AD A030 459
- PP 164  
Mahoney, Robert B., Jr., "An Assessment of Public and Elite Perceptions in France, The United Kingdom, and the Federal Republic of Germany," 31 pp., Feb 1977 (Presented at Conference "Perception of the U.S. - Soviet Balance and the Political Uses of Military Power" sponsored by Director, Advanced Research Projects Agency, April 1976) AD A036 599
- PP 165  
Jondrow, James M., "Effects of Trade Restrictions on Imports of Steel," 67 pp., November 1976, (Delivered at ILAB Conference in Dec 1976)
- PP 166 - Revised  
Feldman, Paul, "Why It's Difficult to Change Regulation," Oct 1976, AD A037 682
- PP 167  
Kleinman, Samuel, "ROTC Service Commitments: A Comment," 4 pp., Nov 1976, (Published in Public Choice, Vol. XXIV, Fall 1976) AD A033 305
- PP 168  
Lockman, Robert F., "Revalidation of CNA Support Personnel Selection Measures," 36 pp., Nov 1976
- PP 169  
Jacobson, Louis S., "Earnings Losses of Workers Displaced from Manufacturing Industries," 38 pp., Nov 1976, (Delivered at ILAB Conference in Dec 1976), AD A039 809
- PP 170  
Brechtling, Frank P., "A Time Series Analysis of Labor Turnover," Nov 1976, (Delivered at ILAB Conference in Dec 1976)
- PP 171  
Ralston, James M., "A Diffusion Model for GaP Red LED Degradation," 10 pp., Nov 1976, (Published in Journal of Applied Physics, Vol. 47, pp. 4518-4527, Oct 1976)
- PP 172  
Classen, Kathleen P., "Unemployment Insurance and the Length of Unemployment," Dec 1976, (Presented at the University of Rochester Labor Workshop on 16 Nov 1976)
- PP 173  
Kleinman, Samuel D., "A Note on Racial Differences in the Added Worker/Discouraged Worker Controversy," 2 pp., Dec 1976, (Published in the American Economist, Vol. XX, No. 1, Spring 1976)
- PP 174  
Mahoney, Robert B., Jr., "A Comparison of the Brookings and International Incidents Projects," 12 pp., Feb 1977 AD A037 206
- PP 175  
Levine, Daniel, Stoloff, Peter and Spruill, Nancy, "Public Drug Treatment and Addict Crime," June 1976, (Published in Journal of Legal Studies, Vol. 5, No. 2)
- PP 176  
Felix, Wendy, "Correlates of Retention and Promotion for USNA Graduates," 38 pp., Mar 1977, AD A039 040
- PP 177  
Lockman, Robert F. and Warner, John T., "Predicting Attrition: A Test of Alternative Approaches," 33 pp., Mar 1977 (Presented at the OSD/ONR Conference on Enlisted Attrition, Xerox International Training Center, Leesburg, Virginia, 4-7 April 1977), AD A039 047
- PP 178  
Kleinman, Samuel D., "An Evaluation of Navy Unrestricted Line Officer Accession Programs," 23 pp., April 1977, (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977), AD A039 048

\*CNA Professional Papers with an AD number may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22151. Other papers are available from the Management Information Office, Center for Naval Analyses, 2000 North Beauregard Street, Alexandria, Virginia 22311. An Index of Selected Publications is also available on request. The index includes a Listing of Professional Papers, with abstracts, issued from 1969 to February 1978.

- PP 179  
Stoloff, Peter H. and Balut, Stephen J., "Vacate: A Model for Personnel Inventory Planning Under Changing Management Policy," 14 pp., April 1977. (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977), AD A039 049
- PP 180  
Horowitz, Stanley A. and Sherman, Allan, "The Characteristics of Naval Personnel and Personnel Performance," 16 pp., April 1977. (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977), AD A039 050
- PP 181  
Balut, Stephen J. and Stoloff, Peter, "An Inventory Planning Model for Navy Enlisted Personnel," 35 pp., May 1977 (Prepared for presentation at the Joint National Meeting of the Operations Research Society of America and The Institute for Management Science, 9 May 1977, San Francisco, California), AD A042 221
- PP 182  
Murray, Russell, 2nd, "The Quest for the Perfect Study or My First 1138 Days at CNA," 57 pp., April 1977
- PP 183  
Kassing, David, "Changes in Soviet Naval Forces," 33 pp., November, 1976, (Published as part of Chapter 3, "General Purpose Forces: Navy and Marine Corps," in Arms, Men, and Military Budgets, Francis P. Hoerber and William Schneider, Jr. (eds.), (Crane, Russak & Company, Inc.: New York), 1977), AD A040 106
- PP 184  
Lockman, Robert F., "An Overview of the OSD/ONR Conference on First Term Enlisted Attrition," 22 pp., June 1977. (Presented to the 39th MORS Working Group on Manpower and Personnel Planning, Annapolis, Md., 28-30 Jun 1977), AD A043 618
- PP 185  
Kassing, David, "New Technology and Naval Forces in the South Atlantic," 22 pp. (This paper was the basis for a presentation made at the Institute for Foreign Policy Analyses, Cambridge, Mass., 28 April 1977), AD A043 619
- PP 186  
Mizrahi, Maurice M., "Phase Space Integrals, Without Limiting Procedure," 31 pp., May 1977. (Invited paper presented at the 1977 NATO Institute on Path Integrals and Their Application in Quantum Statistical and Solid State Physics, Antwerp, Belgium, July 17-30, 1977) (Published in Journal of Mathematical Physics 19(1), p. 298, Jan 1978), AD A040 107
- PP 187  
Coile, Russell C., "Nomography for Operations Research," 35 pp., April 1977 (Presented at the Joint National Meeting of the Operations Research Society of America and The Institute for Management Services, San Francisco, California, 9 May 1977), AD A043 620
- PP 188  
Durch, William J., "Information Processing and Outcome Forecasting for Multilateral Negotiations: Testing One Approach," 53 pp., May 1977 (Prepared for presentation to the 18th Annual Convention of the International Studies Association, Chase-Park Plaza Hotel, St. Louis, Missouri, March 16-20, 1977), AD A042 222
- PP 189  
Coile, Russell C., "Error Detection in Computerized Information Retrieval Data Bases," July, 1977, 13 pp. (Presented at the Sixth Cranfield International Conference on Mechanized Information Storage and Retrieval Systems, Cranfield Institute of Technology, Cranfield, Bedford, England, 26-29 July 1977), AD A043 580
- PP 190  
Mahoney, Robert B., Jr., "European Perceptions and East-West Competition," 96 pp., July 1977 (Prepared for presentation at the annual meeting of the International Studies Association, St. Louis, Mo., March, 1977), AD A043 661
- PP 191  
Sawyer, Ronald, "The Independent Field Assignment: One Man's View," August 1977, 25 pp.
- PP 192  
Holen, Arlene, "Effects of Unemployment Insurance Entitlement on Duration and Job Search Outcome," August 1977, 6 pp., (Reprinted from Industrial and Labor Relations Review, Vol., 30, No. 4, Jul 1977)
- PP 193  
Horowitz, Stanley A., "A Model of Unemployment Insurance and the Work Test," August 1977, 7 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)
- PP 194  
Classen, Kathleen P., "The Effects of Unemployment Insurance on the Duration of Unemployment and Subsequent Earnings," August 1977, 7 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)
- PP 195  
Brechling, Frank, "Unemployment Insurance Taxes and Labor Turnover: Summary of Theoretical Findings," 12 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)
- PP 196  
Ralston, J. M. and Lorimer, O. G., "Degradation of Bulk Electroluminescent Efficiency in Zn O Doped GaP LEDs," July 1977, 3 pp. (Reprinted from IEEE Transactions on Electron Devices, Vol. ED-24, No. 7, July 1977)
- PP 197  
Wells, Anthony R., "The Centre for Naval Analyses," 14 pp., Dec 1977 AD A049 107
- PP 198  
Classen, Kathleen P., "The Distributional Effects of Unemployment Insurance," 25 pp. Sept. 1977 (Presented at a Hoover Institution Conference on Income Distribution, Oct 7-8, 1977), AD A054 423
- PP 199  
Durch, William J., "Revolution From A.F.A.R. - The Cuban Armed Forces in Africa and the Middle East," Sep 1977, 16 pp., AD A046 268
- PP 200  
Powers, Bruce F., "The United States Navy," 40 pp. Dec 1977 (Published as a chapter in The U.S. War Machine by Salamander Books, England, 1978), AD A049 108
- PP 201  
Durch, William J., "The Cuban Military in Africa and The Middle East: From Algeria to Angola," Sep 1977, 67 pp., AD A045 675
- PP 202  
Feldman, Paul, "Why Regulation Doesn't Work," (Reprinted from Technological Change and Welfare in the Regulated Industries and Review of Social Economy, Vol. XXIX, March, 1971, No. 1.) Sep 1977, 8 pp.
- PP 203  
Feldman, Paul, "Efficiency, Distribution, and the Role of Government in a Market Economy," (Reprinted from The Journal of Political Economy, Vol. 79, No. 3, May/June 1971.) Sep 1977, 19 pp., AD A045 675
- PP 204  
Wells, Anthony R., "The 1967 June War: Soviet Naval Diplomacy and The Sixth Fleet - A Reappraisal," Oct 1977, 36 pp., AD A047 236
- PP 205  
Coile, Russell C., "A Bibliometric Examination of the Square Root Theory of Scientific Publication Productivity," (Presented at the annual meeting of the American Society for Information Science, Chicago, Illinois, 29 September 1977.) Oct 1977, 6 pp., AD A047 237
- PP 206  
McConnell, James M., "Strategy and Missions of the Soviet Navy in the Year 2000," 48 pp., Nov 1977 (Presented at a Conference on Problems of Sea Power as we Approach the 21st Century, sponsored by the American Enterprise Institute for Public Policy Research, 6 October 1977, and subsequently published in a collection of papers by the Institute), AD A047 244
- PP 207  
Goldberg, Lawrence, "Cost-Effectiveness of Potential Federal Policies Affecting Research & Development Expenditures in the Auto, Steel and Food Industries," 36 pp., Oct 1977, (Presented at Southern Economic Association Meetings beginning 2 November 1977), AD A046 269
- PP 208  
Roberts, Stephen S., "The Decline of the Overseas Station Fleets: The United States Asiatic Fleet and the Shanghai Crisis, 1932," 18 pp., Nov 1977 (Reprinted from The American Neptune, Vol. XXXVII, No. 3, July 1977), AD A047 245
- PP 209 - Classified.
- PP 210  
Kassing, David, "Protecting The Fleet," 40 pp., Dec 1977 (Prepared for the American Enterprise Institute Conference on Problems of Sea Power as We Approach the 21st Century, October 6-7, 1977), AD A049 109

- PP 211  
Mizrahi, Maurice M., "On Approximating the Circular Coverage Function," 14 pp., Feb 1978, AD A054 429
- PP 212  
Mangel, Marc, "On Singular Characteristic Initial Value Problems with Unique Solutions," 20 pp., Jun 1978, AD A058 535
- PP 213  
Mangel, Marc, "Fluctuations in Systems with Multiple Steady States. Application to Lanchester Equations," 12 pp., Feb 78, (Presented at the First Annual Workshop on the Information Linkage Between Applied Mathematics and Industry, Naval PG School, Feb 23-25, 1978), AD A071 472
- PP 214  
Weinland, Robert G., "A Somewhat Different View of The Optimal Naval Posture," 37 pp., Jun 1978 (Presented at the 1976 Convention of the American Political Science Association (APSA/IUS Panel on "Changing Strategic Requirements and Military Posture"), Chicago, Ill., September 2, 1976), AD A056 228
- PP 215  
Coile, Russell C., "Comments on: Principles of Information Retrieval by Manfred Kochen," 10 pp., Mar 78, (Published as a Letter to the Editor, Journal of Documentation, Vol. 31, No. 4, pages 298-301, December 1975), AD A054 426
- PP 216  
Coile, Russell C., "Lotka's Frequency Distribution of Scientific Productivity," 18 pp., Feb 1978, (Published in the Journal of the American Society for Information Science, Vol. 28, No. 6, pp. 366-370, November 1977), AD A054 425
- PP 217  
Coile, Russell C., "Bibliometric Studies of Scientific Productivity," 17 pp., Mar 78, (Presented at the Annual meeting of the American Society for Information Science held in San Francisco, California, October 1976), AD A054 442
- PP 218 - Classified.
- PP 219  
Huntzinger, R. LaVar, "Market Analysis with Rational Expectations: Theory and Estimation," 60 pp., Apr 78, AD A054 422
- PP 220  
Maurer, Donald E., "Diagonalization by Group Matrices," 26 pp., Apr 78, AD A054 443
- PP 221  
Weinland, Robert G., "Superpower Naval Diplomacy in the October 1973 Arab-Israeli War," 76 pp., Jun 1978, AD A055 564
- PP 222  
Mizrahi, Maurice M., "Correspondence Rules and Path Integrals," 30 pp., Jun 1978 (Invited paper presented at the CNRS meeting on "Mathematical Problems in Feynman's Path Integrals," Marseille, France, May 22-26, 1978), AD A055 536
- PP 223  
Mangel, Marc, "Stochastic Mechanics of Molecule Molecule Reactions," 21 pp., Jun 1978, AD A056 227
- PP 224  
Mangel, Marc, "Aggregation, Bifurcation, and Extinction in Exploited Animal Populations," 48 pp., Mar 1978, AD A058 536  
\*Portions of this work were started at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, B.C., Canada
- PP 225  
Mangel, Marc, "Oscillations, Fluctuations, and the Hopf Bifurcation," 43 pp., Jun 1978, AD A058 537  
\*Portions of this work were completed at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, Canada.
- PP 226  
Ralston, J. M. and J. W. Mann, "Temperature and Current Dependence of Degradation in Red-Emitting GaP LEDs," 34 pp., Jun 1978, AD A058 538  
\*Bell Telephone Laboratories, Inc.
- PP 227  
Mangel, Marc, "Uniform Treatment of Fluctuations at Critical Points," 50 pp., May 1978, AD A058 539
- PP 228  
Mangel, Marc, "Relaxation at Critical Points: Deterministic and Stochastic Theory," 54 pp., Jun 1978, AD A058 540
- PP 229  
Mangel, Marc, "Diffusion Theory of Reaction Rates. I: Formulation and Einstein-Smoluchowski Approximation," 50 pp., Jan 1978, AD A058 541
- PP 230  
Mangel, Marc, "Diffusion Theory of Reaction Rates. II Ornstein-Uhlenbeck Approximation," 34 pp., Feb 1978, AD A058 542
- PP 231  
Wilson, Desmond P., Jr., "Naval Projection Forces: The Case for a Responsive MAF," Aug 1978, AD A058 543
- PP 232  
Jacobson, Louis, "Can Policy Changes Be Made Acceptable to Labor?" Aug 1978 (Submitted for publication in Industrial and Labor Relations Review), AD A061 528
- PP 233  
Jacobson, Louis, "An Alternative Explanation of the Cyclical Pattern of Quites," 23 pp., Sep 1978
- PP 234 - Revised  
Jondrow, James and Levy, Robert A., "Does Federal Expenditure Displace State and Local Expenditure: The Case of Construction Grants," 25 pp., Oct 1979 PP 235
- PP 235  
Mizrahi, Maurice M., "The Semiclassical Expansion of the Anharmonic-Oscillator Propagator," 41 pp., Oct 1978 (To appear in the Journal of Mathematical Physics), AD A061 538
- PP 237  
Maurer, Donald, "A Matrix Criterion for Normal Integral Bases," 10 pp., Jan 1979
- PP 238  
Utgoff, Kathleen Classen, "Unemployment Insurance and The Employment Rate," 20 pp., Oct 1978, AD A061 527
- PP 239  
Trost, R. P. and Warner, J. T., "The Effects of Military Occupational Training on Civilian Earnings: An Income Selectivity Approach," 38 pp., Nov 1979, AD A077 831
- PP 240  
Powers, Bruce, "Goals of the Center for Naval Analyses," 13 pp., Dec 1978, AD A063 759
- PP 241  
Mangel, Marc, "Fluctuations at Chemical Instabilities," 24 pp., Dec 1978 (Published in Journal of Chemical Physics, Vol. 69, No. 8, Oct 15, 1978), AD A063 787
- PP 242  
Simpson, William R., "The Analysis of Dynamically Interactive Systems (Air Combat by the Numbers)," 60 pp., Dec 1978, AD A063 760
- PP 243  
Simpson, William R., "A Probabilistic Formulation of Murphy Dynamics as Applied to the Analysis of Operational Research Problems," 18 pp., Dec 1978, AD A063 761
- PP 244  
Sherman, Allan and Horowitz, Stanley A., "Maintenance Costs of Complex Equipment," 20 pp., Dec 1978, AD A071 473
- PP 245  
Simpson, William R., "The Accelerometer Methods of Obtaining Aircraft Performance from Flight Test Data (Dynamic Performance Testing)," 403 pp., Jun 1979, AD A075 226
- PP 246  
Brechling, Frank, "Layoffs and Unemployment Insurance," 35 pp., Feb 1979
- PP 248  
Thomas, James A., Jr., "The Transport Properties of Dilute Gases in Applied Fields," 183 pp., Mar 1979
- PP 249  
Glasser, Kenneth S., "A Secretary Problem with a Random Number of Choices," 23 pp., Mar 1979
- PP 250  
Mangel, Marc, "Modeling Fluctuations in Macroscopic Systems," 26 pp., Jun 1979
- PP 251  
Trost, Robert P., "The Estimation and Interpretation of Several Selectivity Models," 37 pp., Jun 1979, AD A075 941
- PP 252  
Nunn, Walter R., "Position Finding with Prior Knowledge of Covariance Parameters," 5 pp., Jun 1979

- PP 253  
Glasser, Kenneth S., "The d-Choice Secretary Problem," 32 pp., Jun 1979, AD A075 225
- PP 254  
Mangel, Marc and Quanbeck, David B., "Integration of a Bivariate Normal Over an Offset Circle," 14 pp., Jun 1979
- PP 255 - Classified
- PP 256  
Maurer, Donald E., "Using Personnel Distribution Models," 27 pp., Feb 1980
- PP 257  
Thaler, R., "Discounting and Fiscal Constraints: Why Discounting is Always Right," 10 pp., Aug 1979, AD A075 224
- PP 258  
Mangel, Marc S. and Thomas, James A., Jr., "Analytical Methods in Search Theory," 86 pp., Nov 1979, AD A077 832
- PP 259  
Glass, David V., Hsu, Ih-Ching, Nunn, Walter R. and Perin, David A., "A Class of Commutative Markov Matrices," 17 pp., Nov 1979, AD A077 833
- PP 260  
Mangel, Marc S. and Cope, Davis K., "Detection Rate and Sweep Width in Visual Search," 14 pp., Nov 1979, AD A077 834
- PP 261  
Vila, Carlos L., Zvijac, David J. and Ross, John, "Franck-Condon Theory of Chemical Dynamics. VI. Angular Distributions of Reaction Products," 14 pp., Nov 1979 (Reprinted from *Journal Chem. Phys.* 70(12), 15 Jun 1979), AD A076 287
- PP 262  
Petersen, Charles C., "Third World Military Elites in Soviet Perspective," 50 pp., Nov 1979, AD A077 835
- PP 263  
Robinson, Kathy I., "Using Commercial Tankers and Containerships for Navy Underway Replenishment," 25 pp., Nov 1979, AD A077 836
- PP 264  
Weinland, Robert G., "The U.S. Navy in the Pacific: Past, Present, and Glimpses of the Future," 31 pp., Nov 1979, AD A066 837
- PP 265  
Weinland, Robert G., "War and Peace in the North: Some Political Implications of the Changing Military Situation in Northern Europe," 18 pp., Nov 1979, AD A077 838
- PP 266  
Utgoff, Kathy Classen, and Brechling, Frank, "Taxes and Inflation," 25 pp., Nov 1979
- PP 267  
Trost, Robert P., and Vogel, Robert C., "The Response of State Government Receipts to Economic Fluctuations and the Allocation of Counter-Cyclical Revenue Sharing Grants," 12 pp., Dec 1979 (Reprinted from the *Review of Economics and Statistics*, Vol. LXI, No. 3, August 1979)
- PP 268  
Thomason, James S., "Seaport Dependence and Inter-State Cooperation: The Case of Sub-Saharan Africa," 141 pp., Jan 1980
- PP 269  
Weiss, Kenneth G., "The Soviet Involvement in the Ogaden War," 42 pp., Jan 1980
- PP 270  
Remnek, Richard, "Soviet Policy in the Horn of Africa: The Decision to Intervene," 52 pp., Jan 1980 (To be published in "Soviet Policy in the Third World: Success and Failure," ed. by Robert H. Donaldson, Westview Publishing Co., Boulder, Co., Summer 1980)
- PP 271  
McConnell, James, "Soviet and American Strategic Doctrines: One More Time," 43 pp., Jan 1980
- PP 273  
Nakada, Michael K., "Labor Supply of Wives with Husbands Employed Either Full Time or Part Time," 39 pp., Mar 1980
- PP 275  
Goldberg, Lawrence, "Recruiters Advertising and Navy Enlistments," 34 pp., Mar 1980